UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to:
2003/00511

June 20, 2003

Kemper McMaster
State Supervisor, U.S. Fish and Wildlife Service
Oregon State Office
2600 SE 98th Ave, Suite 100
Portland, OR 97266

Re: Reinitiation of Endangered Species Act Formal Section 7 Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Invasive Species Management Strategy at Gresham Woods as Part of the Greenspaces Program, Multnomah County, Oregon

Dear Mr. McMaster:

Enclosed is a biological opinion (Opinion) prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) pursuant to section 7 of the Endangered Species Act that addresses the proposed Invasive Species Management Strategy at Gresham Woods as part of the Greenspaces Program in the Johnson Creek Basin, Multnomah County, Oregon. Informal section 7 consultation with NOAA Fisheries was completed for this project in June, 2002 (refer to: 2002/00429). In this previous consultation, approved herbicide use was limited to Rodeo® within the 100-year floodplain or 50 feet from the top of bank. The project proponents are now requesting the use of the herbicide Garlon® 3A within the floodplain, and NOAA Fisheries received a request to consult formally on the use of Garlon® 3A on May 5, 2003. NOAA Fisheries concludes in this Opinion that the proposed action is not likely to jeopardize Lower Columbia River (LCR) steelhead (*Onchorynchus mykiss*) and LCR chinook salmon (*O. tshawytscha*). This Opinion includes reasonable and prudent measures with terms and conditions that are necessary and appropriate to minimize the potential for incidental take associated with this project.

This document also serves as consultation on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations at 50 CFR Part 600. Johnson Creek has been designated as EFH for chinook salmon and coho salmon (*O. kisutch*).

If you have any questions regarding this consultation please contact Dr. Nancy Munn of my staff in the Oregon Habitat Branch, at 503.231.6269.

Sincerely,

for Michael R Crouse

D. Robert Lohn
Regional Administrator

cc: James Allison, City of Portland, Environment Services
Michael Reed, City of Portland, Endangered Species Program
Kathy Majidi, City of Gresham, ESA Coordinator

Endangered Species Act - Section 7 Consultation
Biological Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Invasive Species Management Strategy
at the
Gresham Woods Conservation and Restoration Project,
Johnson Creek, Multnomah County, Oregon

Agency: U.S. Fish and Wildlife Service

Consultation Conducted By: NOAA's National Marine Fisheries Service, Northwest Region

Date Issued: June 20, 2003

Issued by: For Michael R Crouse
D. Robert Lohn
Regional Administrator

Refer to: **2003/00511**

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1. INTRODUCTION

1.1 Consultation History

On May 5, 2003, NOAA's National Marine Fisheries Service (NOAA Fisheries) received a letter and biological assessment (BA) from the U.S. Fish and Wildlife Service (USFWS) requesting formal Endangered Species Act (ESA) consultation on the effects of the proposed Invasive Species Management Strategy at the Gresham Woods site of the Greenspaces Program on Lower Columbia River (LCR) steelhead (*Oncorhyncus mykiss*) and LCR chinook salmon (*O. tshawytscha*). The USFWS also requested essential fish habitat (EFH) consultation under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) for chinook salmon and coho salmon (*O. kisutch*). The City of Portland's (City's) Watershed Revegetation Program (WRP) is leading this project and working in partnership with the City of Gresham. The Gresham Woods project is on a 71-acre site adjacent to Johnson Creek, a tributary to the Willamette River. The site is publicly owned and managed by the City of Gresham. The area is currently dominated by Himalyan blackberry (*Rubus discolor*) with patches of non-native pasture grasses, reed canarygrass (*Phalaris arundinaceae*), and some native trees. This revegetation project is part of the Greenspaces Program, a program initiated by USFWS and Metro in 1991 to address natural resource issues in rapidly urbanizing areas of the Portland metropolitan area. The program is supported by Federal funds, the majority of which are allocated through grants to habitat restoration, conservation, and environmental education projects.

An informal section 7 ESA and EFH consultation was completed for this project in June 2002. At that time, due to concerns about the use of herbicides and the potential for affects to listed fish, the original proposal was modified to restrict the use of herbicides to only Rodeo® (glyphosate) and LI-700 within the 100-year floodplain, or within 50 feet from the top of the bank, whichever was greater. The use of Garlon® 3A and Roundup were withdrawn from the City's proposal after discussions with USFWS and NOAA Fisheries, based on the assumption that there may be a viable project alternative that would reduce the risk of adverse effects on listed fish.

During 2002 and 2003, the City worked to restore the Gresham Woods site using only Rodeo® and LI-700. The City monitored the results and evaluated the effectiveness of Rodeo® with LI-700 in achieving project goals. These results have been compared with the use of Garlon® 3A at other locations and in upland areas at the Gresham Woods site. The findings show that Rodeo® has been ineffective at achieving the project goals of eliminating the Himalayan blackberry and other broadleaf invasive weeds. The City has found that weed coverage has actually increased in their monitoring plots, and some erosion has occurred due to the difficulty of establishing native grass cover that would otherwise stabilize soils in the floodplain. This is because the native grasses that have been seeded immediately adjacent to and under the desirable native trees and shrubs are inadvertently killed by Rodeo® . For these reasons, the City has requested the use of Garlon® 3A in the Johnson Creek floodplain because Garlon® 3A has been found to be effective against the targeted non-native broadleaf plant species without adversely impacting the native plants and grasses that the City is attempting to establish.

Consequently, the USFWS has requested a re-initiation of consultation for this project to include the use of Garlon® 3A as an added component to the work previously evaluated though the 2002 informal consultation. The USFWS determined in the BA and letter received May 5, 2003, that the proposed action is "likely to adversely affect" LCR steelhead and LCR chinook salmon.

LCR steelhead were listed as threatened under the ESA on March 19, 1998 (63 FR 13347), and protective regulations were issued on July 10, 2000 (65 FR 42422). Biological information and data on population trends for LCR steelhead can be found in Busby *et al.* (1995, 1996). LCR chinook salmon were listed as threatened under the ESA on March 24, 1999 (64 FR 14308) and protective regulations were issued on July 10, 2000 (65 FR 42422). Biological information and data on population trends for LCR chinook salmon can be found in Myers *et al.* (1998) and Healey (1991).

The objective of this biological opinion (Opinion) is to determine whether using Garlon® 3A and Rodeo® with LI-700 as the adjuvant to remove invasive, non-native plants in the floodplain of Johnson Creek is likely to jeopardize the continued existence of LCR steelhead and LCR chinook salmon.

The objective of the EFH consultation is to determine whether the proposed action may adversely affect designated EFH for coho salmon and chinook salmon, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

1.2 Proposed Action

The City proposes to continue its work to eradicate non-native plant species in Gresham Woods, and to establish native shrubs, trees and grasses. The project is located along Johnson Creek in Gresham, Oregon. Johnson Creek is a tributary to the Willamette River. Although the Gresham Woods site is 71 acres, the proposed action is limited to 20 contiguous acres of the property along approximately two miles of Johnson Creek. This area is currently dominated by Himalayan blackberry with patches of non-native pasture grasses, reed canarygrass, and some native tree overstory consisting primarily of red alder, Oregon ash, and black cottonwood. The city would like to establish stands of ash and willow, black cottonwood, mixed conifer-deciduous, wet meadow, and wetland shrub-scrub habitats.

Enhancement of the 20 contiguous riparian and upland acres would occur by actively working to remove invasive non-native plants including Himalayan blackberry, reed canarygrass, and non-native pasture grasses. This would reduce competition with native species to facilitate natural plant recruitment, and prepare areas for active revegetation with native species. The invasive plants will first be cut using mowers, chainsaws, and line trimmers. Regrowth of the non-native plants will then be treated with Rodeo® or Garlon® 3A using a backpack sprayer, and pulled and cut using manual and mechanical methods. Herbicides would be used in strict accordance with the guidelines set forth under the City's Pest Management Policy. Effectiveness would be monitored and evaluated to allow for adaptive management that would guide on-going maintenance activities.

Proposed Herbicides and Quantities

The City plans to use the systemic herbicides Rodeo® (glyphosate) and Garlon® 3A (triclopyr). The surfactant LI-700 is proposed to help chemicals adhere to the plants and to prevent drip and drift. The chemicals are diluted to between 0.5% and 1.5% when mixed with water. LI-700 may be used at a concentration up to 1%. Depending on the site, between 10 and 50 gallons per acre of solution will be applied, so the maximum amount of herbicides would be 0.75 gallons (before dilution) per acre, per application. This volume is for the site preparation phase of the project; less would be applied during the plant establishment phase. Herbicides would be applied by licensed contractors, who will provide their records to City staff.

It is expected that 50 gallons per acre of Garlon® 3A is at the high end of expected use, and is for site preparation when weed cover is 50-90 percent. Maintenance treatments would use 30-75 percent less chemical, depending on the situation.

Method of Application

First, non-native vegetation would be cut or mowed to reduce the plants and make work areas more accessible. Desirable re-growth before spraying is 18 to 42 inches. This height allows for adequate leaf surface, ease of application, minimization of drift (by not needing to hold the spray wand too high), and minimization of drip (by not needing to hold the wand too low to the ground). Because the herbicides are systemic, applicators do not need to spray, soak or burn every leaf. Applications would be spot applied with a hand wand from a backpack sprayer, which utilizes low pressure spray to minimize drift. Garlon® 3A would not be sprayed into standing water (creeks, channels, wetlands, *etc.*), and only Rodeo® with LI-700 would be used in areas with saturated soil.

Frequency of Treatments

Garlon® 3A would be applied no more than three times annually in 2003, 2004, and 2005. The City expects to use two applications annually, but it could range from one to three applications per year. The grant period ends in 2005, and it is not known whether herbicide spraying would still be needed after this time, and whether funds would be available to continue the herbicide application. It is anticipated that using Garlon® 3A , the City would tend to spray less frequently as the project progresses, and as desirable and tolerable groundcovers are favored.

The following is a summary of conservation measures that would be followed, as described in the BA:

1. Herbicide products would be limited to Rodeo® and Garlon® 3A, and the surfactant LI-700 to help the chemicals adhere to plants and to prevent drip and drift.

2. Garlon® 3A would not be applied more than three times per year from 2003 through 2005.
3. Solutions would be low in herbicide concentration (between 0.5% and 1.5% herbicide mixed with water); the actual amount of herbicide to be used per acre is not expected to exceed 0.75 gallons prior to dilution.
4. All contractors would be licensed, and would be required to provide their records to City staff.
5. Plants would be sprayed at the optimum height (approximately 18-24 inches) to allow for adequate leaf surface, ease of application, minimization of drift, and minimization of drip.
6. Herbicide would be applied using a spot-spray method with a hand wand from a low pressure backpack sprayer to minimize drift.
7. No spraying would occur during rain or high wind (over 6 miles per hour) events, or if precipitation has been forecasted within 24 hours of spraying.
8. Disturbed open areas would be seeded with native species to compete against noxious weeds.

2. ENDANGERED SPECIES ACT

2.1 Biological Opinion

2.1.1 Biological Information

The action area is defined by NOAA Fisheries regulations (50 CFR 402) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The proposed action area includes the streambed, streambanks, and riparian area of Johnson Creek from the upstream edge of the 20-acre parcel, downstream to the edge of the Gresham Woods site, or to the downstream limit of detectable levels of applied herbicide, whichever is greater.

Essential features of the adult spawning, juvenile rearing, and adult and juvenile migratory habitats for LCR steelhead and LCR chinook salmon are substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food (juvenile only), riparian vegetation, space, and safe passage conditions (50 CFR 226.212). The essential feature that the proposed project may affect are substrate, water quality, water temperature, food, and riparian vegetation. Johnson Creek within the action area serves as a rearing and migration area for listed salmonids.

According to a recent draft of "Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead," drafted by the West Coast Salmon Biological Review Team (BRT), a number of ESUs were determined by the majority of the BRT "likely to become endangered in the foreseeable future" including LCR chinook and LCR steelhead (NOAA Fisheries 2003). Preliminary conclusions for each listed ESU considered in this Opinion are discussed below.

Lower Columbia River Chinook

According to the BRT report (NOAA Fisheries 2003), the LCR chinook salmon ESU is substantially modified from the historical population structure. Most tule fall chinook populations are potentially at risk of extinction, and no populations of the spring run life-history type are currently considered self-sustaining.

The new BRT report (NOAA Fisheries 2003) stated that all of the risk factors identified in previous reviews were still considered important. They have estimated that eight to 10 historic populations in this ESU have been extirpated, most of them spring run. The majority of the spring-run populations have been extirpated largely as the result of dams blocking access to their high elevation habitat. Although some natural production currently occurs in 20 or so populations, only one exceeds 1,000 spawners. High hatchery production continues to pose genetic and ecological risks to natural populations. Most populations in this ESU have not seen pronounced increases in recent years, as has occurred in other geographic areas.

Threats to chinook spawning and rearing habitat in the Lower Columbia River ESU continue to be habitat degradation and loss due to extensive hydropower development projects, urbanization, logging and agriculture.

According to the BA, the race of fall chinook that historically spawned in Johnson Creek was the tule. Tules generally remain in the ocean or estuary until nearly mature. By the time they migrate upstream to their spawning grounds, they are dark in color and their flesh has lost most of its oil content. Chinook salmon tend to enter Johnson Creek to spawn between mid-September and mid-November. Fry emerge in February and March, and begin their downstream migration after a couple of weeks. The majority of chinook salmon present in Johnson Creek are most likely stray hatchery spring stock or fall chinook from the Willamette River. One juvenile chinook salmon was collected from reach 1 during surveys in 1992, and several juveniles were collected from a short reach of a downstream tributary (Crystal Springs Creek) in 1993. The Gresham Woods site is within Reach 4. Therefore, it is unlikely that chinook salmon currently occur in the project vicinity, but they may be found in low numbers several miles downstream near the confluence with the Willamette River.

Lower Columbia River Steelhead

Based on the updated information provided in LCR status reviews and the 2003 BRT report, the number of historical and currently viable populations have been tentatively identified. Like the previous BRT, the current BRT could not conclusively identify a single population that is naturally self-sustaining. Over the period of the available time series, most of the populations are in decline and are at relatively low abundance (no population has a recent mean greater than 750 spawners). In addition, many of the populations continue to have a substantial fraction of hatchery origin spawners and may not be naturally self-sustaining.

Steelhead depend more on freshwater habitat than most salmon species, relying heavily on rivers and streams as nursery areas. Steelhead penetrate farther into headwater areas, and do not usually die after spawning. According to the BA, winter steelhead are known to occur in Kelley

Creek, a tributary to Johnson Creek approximately two miles downstream of the Gresham Woods Property. In the last 15 years, steelhead have been found in most reaches of Johnson Creek as far upstream as Gresham. This includes the project reach.

2.1.2 Evaluating Proposed Action

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR Part 402 (the consultation regulations). In conducting analyses of habitat-altering actions under section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations combined with the Habitat Approach (NMFS 1999): (1) Consider the status and biological requirements of the species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed or continuing action on the species and whether the action is consistent with the available recovery strategy; (4) consider cumulative effects; and (5) determine whether the proposed action, in light of the above factors, is likely to appreciably reduce the likelihood of species survival in the wild. In completing this step of the analysis, NOAA Fisheries determines whether the action under consultation, together with cumulative effects when added to the environmental baseline, is likely to jeopardize the ESA-listed species. If the action is likely to jeopardize the species, NOAA Fisheries will identify reasonable and prudent alternatives for the action that avoid jeopardy.

2.1.3 Biological Requirements

The first step in the methods NOAA Fisheries uses for applying the ESA section 7(a)(2) to listed salmonids is to define the species' biological requirements that are most relevant to each consultation. NOAA Fisheries also considers the current status of the listed species taking into account population size, trends, distribution and genetic diversity. To assess the current status of the listed species, NOAA Fisheries starts with information considered in its decision to list LCR steelhead and LCR chinook salmon for ESA protection then considers new data available that are relevant to the determination.

The relevant biological requirements are those necessary for LCR steelhead and LCR chinook salmon to survive and recover to naturally-reproducing population levels, at which time protection under the ESA would become unnecessary. Adequate population levels must safeguard the genetic diversity of the listed stock, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment.

For this consultation, the biological requirements are improved habitat characteristics that function to support successful adult and juvenile migration, juvenile rearing, and adult spawning. LCR steelhead and LCR chinook salmon survival in the wild depends upon the proper functioning of certain ecosystem processes, including habitat formation and maintenance. Restoring functional habitats depends largely on allowing natural processes to increase their ecological function, while removing adverse impacts of current practices. In conducting analyses of habitat-altering actions, NOAA Fisheries defines the biological requirements in terms of a concept called Properly Functioning Condition (PFC) and applies a "habitat approach" to its analysis (NMFS 1999). The current status of LCR steelhead and LCR chinook salmon, based upon their risk of extinction, has not significantly improved since the species were listed.

2.1.4 Environmental Baseline

In step 2 of NOAA Fisheries' analysis, we evaluate the relevance of the environmental baseline in the action area to the species' current status. The environmental baseline is an analysis of the effects of past and ongoing human-caused and natural factors leading to the current status of the species or its habitat and ecosystem within the action area. Environmental baseline conditions within the action area were evaluated for the subject action at the project level and watershed scales. This evaluation was based on the matrix of pathways and indicators (MPI) described in *Making Endangered Species Act Determinations of Effect for Individual or Groups of Actions at the Watershed Scale* (NMFS 1996). This method assesses the current condition of instream, riparian, and watershed factors that collectively provide properly functioning aquatic habitat essential for the survival and recovery of the species.

Johnson Creek is a 34,560-acre (55 square miles) watershed that originates in the hills east of Portland and flows westward approximately 25 miles to its confluence with the Willamette River. There are several major tributaries that drain Johnson Creek, including: Crystal Springs Creek, Kelley Creek, Mitchell Creek, Butler Creek, Hogan Creek, Sunshine Creek, and Badger Creek. Land use ranges from heavily developed areas in the cities of Portland, Milwaukee, and Gresham, to rural farms and nursery lands in the headwaters.

Flow monitoring in Johnson Creek indicates that low flow conditions may adversely impact salmonids (Table 1). The Oregon Department of Fish and Wildlife (ODFW) has set minimum flow targets to protect salmonids in Johnson Creek, and has obtained water rights to maintain those flows (Meross 2000). Flows in the middle and upper watershed frequently do not meet those minimum flows, particularly in spring and summer months. Below Crystal Springs, which provides consistent and abundant groundwater flows, the minimum instream flows are typically met. Statistical evaluation of flow since 1940 indicates some increase in peak flows over the period of record.

Johnson Creek has been substantially altered from its historic geomorphology to a degree that affects the way water moves through the watershed. Diking, channelization, and other alterations of the natural floodplain have eliminated many of the areas that once absorbed and conveyed floods. One of the most significant alterations occurred in the 1930's when the Works Progress Administration widened, deepened, rock-lined, and channelized 15 miles of the 25-mile creek in an attempt to control flooding. These alterations have had long-lasting and marked effects on the habitat and hydrology of the watershed. Most significantly, the historic floodplain of Johnson Creek is disconnected or minimally connected through much of its length. The lack of floodplain connections means that flood flows cannot spread out and attenuate on the floodplain, but are instead directed and concentrated into the main channel, increasing scour and degrading instream habitat.

ODFW conducted habitat surveys throughout Johnson Creek (ODFW 2000). Their findings indicate that Johnson Creek has extremely low wood volumes, a high percentage of hardened banks, lack of refugia in many reaches, channel incision, and high levels of fine sediment. Riparian vegetation is minimal or lacking throughout much of the watershed. Although there are no culverts on the mainstem until high in the watershed, they are present on nearly all the tributaries to Johnson Creek. Crystal Springs, an area used by resident and migratory Willamette salmonids, has a series of partially impassable culverts along its length, and some of the least developed tributaries along the southern side of the middle watershed also have culverts along their confluences with the mainstem.

Water quality in Johnson Creek is rated as fair to poor. In 1998, Johnson Creek was placed on the 303(d) list by the Oregon Department of Environmental Quality (DEQ) for fecal coliform, DDT and dieldrin. The reach included in this listing was from the mouth of Johnson Creek to milepoint 23.7. In 2002, PCBs and polynuclear aromatic hydrocarbons were added to the 303(d) list.

Commonly used pesticides and herbicides are not being detected at significant levels in Johnson Creek, although DDT and Dieldrin still linger after their banning in the 1970s. Toxic spills may produce more damage. For example, draining chlorinated swimming pools or antifreeze and motor oil from vehicles into storm drains can destroy entire juvenile salmon populations. Periodic testing in Johnson Creek may never detect these incidents.

Water temperatures taken at various times and locations indicate that Johnson Creek can reach dangerously high temperatures in July. Water temperatures above 75º are lethal to steelhead, and above 79º are lethal to salmon. The Oregon Department of Environmental Quality has set a 64º F temperature limit for Johnson Creek. Monitoring results show that summer water temperatures often exceed this limit. Removal of streamside vegetation, heated industrial discharges, summer stormwater run-off, and shallow detentions of water may elevate stream temperature. Temperature and substances like animal waste and fertilizer runoff can also deprive the water of dissolved oxygen, which can impair salmon migration. Tests in the upper mainstem of Johnson Creek found unsatisfactory levels of oxygen dissolved in the water during low flows.

Table 1. Baseline environmental conditions in Johnson Creek.

FACTOR	**BASELINE CONDITION**	**COMMENTS**
HABITAT		

Flow Regime	Not Properly Functioning	Peak flows have increased since 1940s. The historic floodplain is minimally accessible or inaccessible through much of its length. This has directed &concentrated floss into the main channel, increasing scour & degrading instream habitat.
Baseflow	Not Properly Functioning	Summer baseflows do not meet ODFW instream water rights for protection for slamonids.
Channel Characteristics	Not Properly Functioning	Significant channelization, downcutting, & bank erosion has occurred. Channel has been narrowed & confined by hardened banks. The lower 15 miles was widened, deepened, rock-lined &channelized in the 1930s. Habitat has been simplified and natural cover has been replaced.
Riparian Zone	Not Properly Functioning	Watershed development and streamside disturbance has reduced riparian vegetation along many reaches. Such reduction is likely a factor contributing to lack of instream cover, increased water temperature, and streambank erosion.
Fish Passage	Not Properly Functioning	Nearly all of the mainstem is accessible to anadromous salmonids, but passage to nearly all of the tributaries is compromised by one or more culverts.
WATER QUALITY		
Temperature	Not Properly Functioning	Temperatures regularly exceed standards through the summer.
Nutrients, DO, Chl *a*	At Risk	Nutrient concentrations exceed regional guidelines. DO concentrations frequently drop below 8.0 mg/L in summer.
Toxic Materials	At Risk	On the 303(d) list for DDT, dieldrin, PCB, PAHs, and fecal coliform. Instream DDT concentrations measured in a USGS study are among the highest measured in the region (Edwards 1994).
Sediment	Not Properly Functioning	Fine sediment in some reaches are presently at levels that seriously limit fish food production or embed spawning areas.
BIOTA		
Fish Survival	At Risk	The cumulative effects of the factors listed above threaten salmonid survival, and salmonid populations locally and upstream have been greatly reduced from historic numbers.
Biotic Integrity	At Risk	Greatly reduced from historic conditions. Many native species of fish have been extirpated or greatly reduced, and many non-native species currently occupy their habitat. Diversity of aquatic insects is significantly reduced in comparison to reference sites. Productivity is probably greatly reduced compared to historic numbers, resulting in a decrease in prey items for juvenile salmonids.

The fish community in Johnson Creek is dominated by redside shiners, reticulate sculpin, and speckled dace (JCCC 1995). Large scale suckers are abundant in the lower reaches. Adult coho salmon, chinook salmon, cutthroat trout, and steelhead have been observed in the system.

None of the environmental baseline indicators presented in Table 1 are properly functioning. Four of the indicators are at risk, and seven of the indicators demonstrate that watershed functions are not properly functioning. Based on these data, habitat and water quality in Johnson Creek are not adequate to support recovered salmon populations.

2.1.5 Effects of Proposed Action

In step 3 of the jeopardy analysis, NOAA Fisheries evaluates the effects of the proposed action on listed fish and their habitat. The effects determination in this Opinion was made using a method for evaluating current aquatic conditions, the environmental baseline, and predicting effects of actions on them. The effects of the action are expressed in terms of the expected effect (restore, maintain, or degrade) on aquatic habitat factors in the action area. For the proposed action, LCR steelhead and LCR chinook salmon habitat indicators for the action area will either be improved or maintained in the long term.

Effects to stream habitat and fish populations can be separated into direct and indirect effects. Direct effects are those that contribute to the immediate loss or harm of individual fish or embryos (*e.g.*, heavy equipment directly crushing a fish, crushing or destabilizing a redd that results in the actual destruction of embryos, dislodging the embryos from the productive nest and ultimately destroying eggs). Indirect effects are those effects which occur at a later time, causing specific habitat features (*e.g.*, undercut banks, sedimentation of spawning beds, loss of pools), localized reductions in habitat quality (*e.g.*, sedimentation, loss of riparian vegetation, changes in channel stability and structure), which ultimately cause loss or reduction of populations of fish, or reductions in habitat quantity and/or quality.

The application of herbicides in proximity to lakes and river systems can result in the transport of potentially toxic chemicals (active ingredients and/or adjuvants) to surface waters (USGS 1999). Such actions constitute a chemical modification of salmon habitat, and they have the potential to harm threatened or endangered species. Similar to physical forms of habitat modification (*i.e.* activities that increase sedimentation, increase water temperatures, or reduce the volume of water in streams), chemical habitat modification can adversely affect salmon via pathways that are both indirect and direct. In terms of indirect effects, herbicides can impair the essential biological requirements of salmon if they undermine the physical, chemical, or biological processes that collectively support a productive aquatic ecosystem (Preston 2002). The direct effects of herbicides are a concern if they significantly impair the physiological or behavioral performance of salmonids in ways that will reduce growth and survival, migratory success, or reproduction.

To evaluate the risk of harm, affects analyses should proceed according to the following logical sequence:

- Expected environmental concentrations and persistence
- Evidence that the herbicide will enter salmon habitat
- Evidence for impacts to the aquatic food chain (indirect effects)
- Evidence for impacts on salmon health (direct effects)

This analysis of effects will follow the above sequence, beginning with a discussion of what is known about adjuvants, glyphosate, and triclopyr used with these herbicides.

2.1.5.1 Adjuvants

An adjuvant is a substance used in a pesticide to enhance performance. It may be added at the time of formulation or just before treatment. Adjuvants may affect performance of the pesticide, especially herbicides, and pesticide labels will specify if surfactants are required and the amount of active ingredient it must contain (Tredway 2000).

Adjuvants include the following:

1. Surfactants (surface-active ingredients). These are substances that improve the emulsifying, dispersing, spreading, wetting, or other surface-modifying properties of liquids. Surfactants include emulsifying agents, crop oils, concentrates, and stickers.

2. Emulsifying Agents. An emulsion is a mixture of two incompletely mixed liquids, one which is dispersed in the other. Emulsifying agents work to promote the suspension of one liquid in the other. In herbicides, there are two types of emulsions: "Oil-in-water" emulsion, in which the spray mixture in similar to water, and "water-in-oil" emulsion, a rather viscous spray, also called "invert" emulsions. The "oil-in-water" emulsions are widely used in the formulation of herbicides to aid in getting an oil-soluble herbicide dispersed in a water mixture so that the active ingredient may be applied as a water spray. Inert emulsions are used to aid in drift control, to improve resistance of the herbicide treatment to the effects of weather (rain), to improve accuracy of delivery of the herbicide, and to enhance herbicide activity.

3. Wetting Agents (spreaders). Spreaders are added to decrease surface tension in a mixture and cause a larger portion of each spray droplet to come in contact with the surface of the vegetation. The goal is to increase coverage and effectiveness, although it may also alter herbicide selectivity. There are four spreader types: (1) Anionic, which has an electrical charge in water; (2) cationic, which has an electrical charge in water; (3) non-ionic, which does not have an overall electrical charge; and (4) amphoteric, which has positive or negative charges, depending on the pH of the solution. The type of spreader, if any, prescribed by the herbicide label should be selected. Some herbicides are especially sensitive to pH, particularly in the degradation process (Tredway 2000).

4. Drift Control Agents. Drift of herbicide sprays can be a problem in some environments. One way to reduce herbicide drift is to increase the droplet size of the spray. Adjuvants that are used to control drift do so, in part, by reducing the number of fine spray droplets. Thickeners may be used as drift control agents.

5. Crop Oil Concentrates. Products that contain 80-85% petroleum or vegetable oil and 14-20% surfactant and emulsifiers. An "emulsifiable oil", on the other hand, is a product

that contains 98% oil and 1-2% emulsifiers. This group is also called “nonphytotoxic oils” and “phytobland oils.”

6. Stickers. Adjuvants that cause herbicide to stick to foliage and prevent runoff from target vegetation. The desired result is increased effectiveness.

7. Compatibility Agents. Adjuvants that aid in the suspension of herbicides when they are combined with other pesticides or fertilizers. Used primarily when the carrier solution is a liquid fertilizer.

8. Acidifiers and Buffers. Acidifiers are acids that neutralize alkaline solutions and lower pH when added to herbicide, while buffers can change the pH to a certain level and maintain it, even if the alkalinity changes.

9. Antifoaming Agents and Spray Colorants. Defoaming agents and dyes (Treadway 2000).

LI-700 is a non-ionic surfactant. According to the EPA Classification of Inert Ingredients in Pesticides, LI-700 is classified as 4A, which means of “minimal concern” and 4B which means sufficient information to conclude that current use patterns in pesticide products will not adversely affect public health and the environment (USFS 1997). The aquatic acute toxicity on the Material Safety Data Sheet for LI-700 indicates that LI-700 has a 24-hour LC50 of 140 mg/L, and a 96-hour LC50 of 130 mg/L for rainbow trout (Table 2).

Within the herbicide solution proposed for this action, LI-700 may be used at concentrations up to 1%. If the maximum use is 50 gallons/acre of solution, then the maximum amount of LI-700 used would be 0.5 gallons per acre, per application, prior to dilution. The lowest mean monthly flows on Johnson Creek in Gresham occur during August, based on a four-year data record (USGS data monitoring station as Regner Road, http://waterdata.usgs.gov/or/nwis). Mean monthly flow in August is 1.29 ft^3/sec (range: 0.80-1.62). If an accident occurred and 0.5 gallons of LI-700 was dropped into or flushed into Johnson Creek in August, concentrations of LI-700 could exceed the lethality threshold prior to being diluted downstream.

2.1.5.2 Glyphosate

Glyphosate, or N-(phosphonomethyl)glycine, isopropylamine salt, commonly known as Pondmaster®, Ranger®, Roundup®, Rodeo®, and Touchdown®, is registered by the EPA as a GUP (General Use Pesticide). It may be used in formulations with other herbicides (Extoxnet website at: http://ace.orst.edu). Glyphosate is a broad-spectrum, non-selective systemic herbicide used to control grasses, herbaceous plants including deep rooted perennial weeds, brush, some broadleaf trees and shrubs, and some conifers. The registered use rate is 0.3 to 4.0 lbs of active ingredient per acre and may be applied by aerial spraying; spraying from a truck, backpack or hand-held sprayer; wipe application; frill treatment; or cut stump treatment. It is absorbed by leaves, moves rapidly through the plant, acting to prevent production of an essential amino acid that inhibits plant growth. In some plants, glyphosate is metabolized or broken down while other plants do not break it down (Extoxnet website at: http://ace.orst.edu, USDA 2001).

Table 2. The aquatic toxicity of triclopyr, Garlon® 3A, and the proposed surfactant, LI-700®.

	Triclopyr	Garlon® 3A	LI-700®
Rainbow Trout 96-hr LC_{50}	8.4 ppm[1]	420 ppm[2]	130 ppm [5]
Coho Salmon 96-hr LC_{50}		463 ppm[2]	
Chinook Salmon 96-hr LC_{50}	7.8 ppm[1]	275 ppm[2]	
Rainbow Trout 1-hr EC (avoidance)		800 ppm[3]	
Rainbow Trout 6-hr EC (equilibrium)		200 ppm[3]	
Invertebrate 48-hr LC_{50}		1,140 ppm[4]	190 ppm [5]/ 170 ppm [6]
Invertebrate 96-hr LC_{50}	133 ppm[1]		

(1) USFS 2001
(2) SERA 1996
(3) Morgan *et al.* 1991
(4) Information Ventures, Inc. 1995
(5) Lapurga 1996
(6) McLaren/Hart 1995

Glyphosate itself is an acid, but it is commonly used in salt form (isopropylamine salt). It may also be available in acidic or trimethylsulfonium salt forms. It is generally distributed as water-soluble concentrates and powders (Extoxnet website at: http://ace.orst.edu). The applicant for the proposed action has proposed the use of the Rodeo® formulation.

Most commercially-produced glyphosate, such as Accord® and Rodeo®, contain essentially glyphosate (41.5%) and water (58.5%)(USDA 2001). Glyphosate acid and its salts are classified as "moderately toxic" compounds by the EPA. Technical glyphosate acid (parent compound) is "practically nontoxic" to fish and may be "slightly toxic" to aquatic invertebrates. The 96-hour LC50 is 86-140 mg/L in rainbow trout and 120 mg/L in bluegill sunfish. The 48-hour LC50 for glyphosate in daphnia (water flea), an important food source for freshwater fish, is 780 mg/L. The results of a rainbow trout yolk-sac 96-hour LC50 static bioassay yielded results at the 3.4 mg/L level (USGS acute toxicity database website).

There is a very low potential for the compound to build up in the tissues of aquatic invertebrates or other aquatic organisms (Extoxnet website). In one study of bioaccumulation and persistence, glyphosate was applied to two hardwood communities in Oregon coastal forest and none of the 10 coho salmon fingerlings analyzed had detectable levels of the herbicide or its metabolite aminomethylphosphonic acid, although levels were detectable in stream water for three days and in sediment throughout the 55-day monitoring period (toxnet HSDB website).

Looking at the different formulations, the Accord® and Rodeo® formulations (as opposed to glyphosate alone) are practically nontoxic to freshwater fish (LC50 = >1,000 ppm) and aquatic invertebrate animals (LC50 = 930 ppm for *Daphnia*). Glyphosate and its formulations have not been tested for chronic effects in aquatic animals (USDA 2001).

In the aquatic environment with freshwater fish, toxicity appears to increase with increasing temperature and pH. As reported in the Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates (USFWS 1980), glyphosate was twice as toxic to rainbow trout at 17 degrees Celsius than at seven degrees Celsius. With bluegills, toxicity was twice as toxic at 27 degrees Celsius compared to 17 degrees Celsius. Toxicity was also two to four times greater to bluegills and rainbow trout at a pH level of 7.5 to 9.5 than at pH 6.5. However, the EPA states (1993) that glyphosate is stable at pH 3, 6, and 9.

Glyphosate is classified as moderately persistent in soil, with an estimated average half-life of 47 days. Field half-lives range from one to 174 days. It is strongly adsorbed to most soil types, including types with low organic and clay content. Therefore, even though it is also highly soluble in water, it has a low potential for runoff (except as adsorbed to colloidal matter) and leaching. One study estimated that 2% of the applied chemical was lost to runoff.

Microbes appear to be the primary pathway for degradation of phyphsate (biodegradation), while volatilization or photodegradation (photolysis) losses are negligible (Extoxnet website). Under laboratory conditions, glyphosate has been rapidly and completely biodegraded by soil microorganisms under both aerobic and anaerobic conditions. In one study, after 28 days under aerobic conditions, 45-55% of the glyphosate was mineralized using Ray silt loam soil, Lintonia sandy loam soil, and Drummer silty clay loam soil. Norfolk sandy loam mineralized glyphosate at a much slower, but still significant, rate. Under anaerobic conditions, 37.3% of glyphosate incubated with Ray silt loam soil (toxnet HSDB website). Data indicate half-life values of 1.85 and 2.06 days in Kickapoo sandy loam and Dupo silt loam, respectively (USEPA 1993).

Although glyphosate has a low propensity for leaching, it can enter waterbodies by other means, such as overspray, drift, or erosion of contaminated soil. Once in water, glyphosate is strongly adsorbed to any suspended organic or mineral matter and is then broken down primarily by microbes. Sediment adsorption and/or biodegradation represents the major dissipation process in aquatic systems. Half-lives in pond water range from 12 days to 10 weeks (Extoxnet website).

Evidence from studies suggest that glyphosate levels first rise and then fall to a very low, or even undetectable level, in aquatic systems. After glyphosate was sprayed over two streams in rainy British Columbia, levels in the streams rose dramatically after the first rain event, at 27 hours post-application, and fell to undetectable levels at 96 hours post-application. The highest glyphosate residues were found in sediments, indicating strong adsorption characteristics of this herbicide. Residues persisted for the entire 171-day monitoring period. It was found that suspended sediment is not a major mechanism for glyphosate transport in rivers (toxnet HSDB website).

Questions have been raised about the role photodegradation plays once glyphosate is in a waterbody, particularly when laboratory versus field conditions are involved. The EPA states in the Registration Eligiblity Document (1993) that glyphosate is stable to photodegradation in pH 5, 7, and 9 buffered solutions under natural sunlight.

A large concern with glyphosate is the broad spectrum nature of the chemical. It tends to kill native grasses as well as the non-native target species. This leaves the soil vulnerable to erosion. Furthermore, the effectiveness of glyphosate to control blackberries at the Gresham Woods site has been low.

2.1.5.3 Triclopyr

Triclopyr is a pyridine compound that is registered by the EPA as a RUP (Restricted Use Pesticide), meaning that it may be purchased and used only by certified applicators. Trade names for herbicides containing triclopyr include Access, Crossbow, ET, Garlon® , and others. The product formulation used for Garlon® must contain the word 'Danger' on its label.

Triclopyr is a selective systemic herbicide used for control of woody or broadleaf plants (Extoxnet website). It is commonly used along rights-of-way, in forests, on industrial lands, and on grasslands and parklands.

Garlon® 3A (Dow AgroSciences) is a formulation made up of triclopyr triethylamine (TEA) salt (44.4%) and inert ingredients (55.6%). The majority of the inert ingredients (98.2%) have not been identified by the manufacturer. Those inert ingredients that have been identified (water, emulsifiers, surfactants, and ethanol) comprise approximately 1% of the formulation. However, toxicological testing of the Garlon® 3A formulation, including the unidentified ingredients, has occurred.

Triclopyr mimics a natural plant growth hormone, auxin, causing uncontrolled and disorganized growth in susceptible plant species. Triclopyr does not affect grasses at recommended application rates (USFS 2001). Triclopyr is absorbed by plant surfaces (*e.g.*, green bark, leaves, roots, and cut stem surfaces), and moves throughout the plant accumulating in the meristem. As with glyphosate, use of triclopyr would reduce vegetation, though triclopyr would not affect grasses, and thus would be less likely to contribute to local soil erosion.

Garlon® 3A is described as low in toxicity to fish with a 96-hour LC_{50} of 463 ppm (SERA 1996, p. 4-18) (Table 2). This reflects the toxicity of the formulation, and does not consider typical spray application solutions that recommend the use of additional surfactants. Juvenile coho salmon (0+ presmolt) exposed to Garlon® 3A (200 or 320 ppm) for a 4-hour period were found to have significantly ($P<0.05$) elevated plasma lactate levels in blood samples, which may be an indicator of acute physiological stress (Janz *et al.* 1991). However, corroboratory evidence was not found in that other relevant indicators were not significantly elevated. The authors found "juvenile coho salmon were not severely stressed" by the 4-hour Garlon® 3A exposure, although they acknowledged that wild coho salmon stocks may display "more extreme" stress responses than the subject hatchery specimens (Janz *et al.* 1991). Bioconcentration in aquatic species is minimal (SERA 1996).

Persistence in soils is affected by moisture, nutrients, and temperature (Norris *et al.* 1991). TCP (3,5,6-trichloro-2-pyridinol) is the initial degradation product of triclopyr in soil. The half-life of triclopyr in western Oregon soils has been found to range from 75 to 81 days with detectable residues found 477 days after treatment (USFS 2001). In Sweden, triclopyr has been found to last more than 2 years in soils (Norris *et al.* 1991). TCP is also the major degradation product of chlorpyrifos, an insecticide. The half-life of TCP ranges from 8 to 279 days (USFS 2001). TMP is a less frequent product found in smaller amounts. The half-life of TMP is 50 to 300 days (USFS 2001). Carbon dioxide is the final degradation product.

Garlon® 3A is highly soluble in water and has characteristics conducive to leaching (i.e., low adsorption potential) (USFS 2001). Several studies have documented triclopyr entry into streams (Norris *et al.* 1991). However, a laboratory study found "little likelihood that triclopyr will leach from forest applications sites into water" (Norris *et al.* 1991). Forest and pasture field studies have similarly found "little indication that triclopyr will leach substantially" in loamy soils (USFS 2001). Photolysis appears to be the major degradation process in natural waters (Norris et al. 1991) with the degradation product being oxamic acid and other non-chlorinated aliphatics (SERA 1996). Field tests show that the half-life for triclopyr in water exposed to sunlight ranges from three hours to 4.3 days (USFS 2001, Norris *et al.* 1991). In sterile water, which generates a different degradation product, triclopyr has a half-life in the absence of sunlight of approximately three months (SERA 1996). No information is available for the half-life in darkness for natural waters.

A study in Lake Minnetonka, Minnesota, looked at the aquatic dissipation of triclopyr during the treatment of Eurasian milfoil (Petty *et al.* 1998). Water and sediment samples were collected through six weeks posttreatment. Triclopyr and TCP dissipation half-lives in water were 3.7 to 4.7 days, and 4.2 to 7.9 days, respectively. These half lives are substantially shorter than previous studies, and this is the only study that looked at the direct application of triclopyr to the water (as opposed to the terrestrial landscape). Triclopyr and TCP cleared from animals in <11 days, and<14 days. Native plants recovered, and no adverse effects on water quality were found following treatment.

2.1.5.4 Likelihood That an Herbicide Will Enter Salmon Habitat

Invasive species management, including the use of herbicides, is normally conducted in accordance with best management practices (BMPs). These BMPs are intended, in part, to ensure that water quality and stream habitat is not put at risk. In the area of herbicide application, this is done by attempting to provide adequate controls of the sources of herbicide such that contact with waterbodies is limited. The variety of sources include atmospheric deposition, spray drift, surface water runoff, groundwater contamination and intrusion, and direct application. In addition, timing and patterns of herbicide use determine the ability to limit the risk to water contact.

Direct effects resulting from triclopyr, glyphosate, and LI-700 applications are associated with contamination of waterways resulting from drift, leaching, surface water run-off, and direct application. Drift is primarily dependent upon gravity, air movement, and droplet size. The smaller a droplet, the longer it stays aloft in the atmosphere. In still air, a droplet of pesticide the size of 100 microns (mist-size) takes 11 seconds to fall 10 feet. The same size droplet travels 13.4 feet in a one mph wind, and 77 feet in a five mph wind while dropping 10 feet. Application pressure, nozzle size, nozzle type, spray angle, spray volume are all factors in determining droplet size. In general, droplet sizes increase with decreasing pressure and larger nozzle sizes (NebGuide website at http://www.ianr.unl.edu/pubs/pesticides). An indicated droplet size (*i.e.* 300 microns) really represents a median diameter of all droplets. Actual droplet sizes will range from considerably smaller as well as larger than the indicated droplet size. During temperature inversions little vertical air mixing occurs and drift can translocate contaminates several miles (NebGuide website). Low relative humidity and/or high temperature conditions will increase evaporation and the potential for drift.

Post-application direct effects may occur in association with rain events that may transport the chemicals to waterways, which will convey them downstream to chinook salmon or steelhead habitat. The adsorption potential, stability, solubility, and toxicity of a chemical determines the extent to which it will migrate and adversely affect surface waters and groundwater (Spence *et al.* 1996). Triclopyr is highly soluble and is readily leached through the soil. Glyphosate, though very soluble, binds well with organic material in soils and therefore is not leached easily. Their solubility leaves both herbicides susceptible to transport in surface runoff, especially if applications are followed immediately with high rainfall events.

While buffers, application criteria, and concurrent drift monitoring are widely believed to help minimize the risk of drift and runoff, a study looking at BMP effectiveness found partial effectiveness or ineffectiveness across a variety of applications and monitoring periods (Rashin and Graber 1993). Effectiveness of BMPs for the application of six herbicides was gaged relative to meeting Washington State water quality standards, Washington State forest practice rules, and Washington State Department of Agriculture label restrictions. Rashin and Graber (1993) determined that numerous factors influenced the effectiveness of BMPs including: Streamflow regimes; application equipment and operating parameters; relationships between streamflow and operating factors (*e.g.* nozzle configuration); decisions about buffer size or necessity; weather; herbicide used; and topography and other site factors. The authors concluded that improvements to all BMPs were necessary to ensure achievement of water quality standards, and adherence to forest practice rules and product label restrictions. They proposed changes to buffering provisions, more effective measures for determining the presence of surface water in ephemeral streams, specifications on the type of nozzle configurations and orientations, and operational restrictions based on weather conditions (Rashin and Graber 1993).

One tool that has been used to predict the transport of herbicides to salmon habitat is environmental fate and transport modeling. The science of herbicide spray drift modeling is not well developed, and limits the ability to accurately predict herbicide spray drift or runoff potential. While a few general agricultural spray drift models exist, such as the EPA AGDRIFT model which evaluates spray drift in the near-field, and a three-dimensional Gaussian model used to calculate drift from gases, they are ineffective at capturing the effects drift and runoff in the forested or riparian environment. For example, the AGDRIFT model does not address forest canopy cover, droplet runoff of different foliar types, and typical forest topography. Furthermore, the models have not been evaluated for their ability to predict the effectiveness of water quality controls.

Environmental fate models have not been run on the two herbicides, triclopyr and glyphosate, to determine their persistence in the environment. Microbial action appears to be the primary factor in the degradation of glyphosate whereas photolysis is the primary degradation mechanism for triclopyr in both soil and aquatic environments. They are considered moderately persistent in the soil, but persistence is dependent on many variables. Chemical formulations, amount of organic material, soil type, temperatures, soil depth, rainfall amounts, pH, water content, oxygen content all play a role in determining soil persistence. An environment containing dry soil with low microbial presence, which receives periodic high-intensity rainfall events, will be very susceptible to both leaching and surface runoff of glyphosate. This will also be true to a lesser extent with triclopyr.

Given the results reported in the literature, and limitations of modeling and existing BMPs, it appears likely that herbicides will enter salmon habitat as a result of the proposed action. Standard BMPs have been shown to be insufficient to completely eliminate drift and runoff, and modeling, despite their complexities, have not been sufficiently developed to be able to predict the risk of spray drift. Furthermore, the applicant is proposing to use the herbicides to control invasive plants within the riparian area, thus increasing the risk of spray drift or direct application to salmon habitat. However, when used according to the EPA label restrictions, it is unlikely that the herbicides or surfactant will be present in Johnson Creek at sufficient concentrations to cause direct lethal effects. The greatest risk of toxicological effects is during the summer low flow period. The risk of effect should decline over time as the herbicides degrade.

2.1.5.5 Likelihood of Indirect Effects

A risk evaluation for indirect effects should be structured around the following question: Given the expected environmental concentrations, bioavailability, and persistence of the herbicide in salmon habitat, what is the evidence that there will be significant negative impacts on primary production, nutrient dynamics, or the trophic structure of macroinvertebrate communities that support a listed species?

In most cases, there will be scientific uncertainties associated with: (1) The fate of herbicides in streams; (2) the resiliency and recovery of aquatic communities; (3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; (4) the significance of pesticide mixtures; and (5) the mitigating or exacerbating effects of local environmental conditions. Where appropriate, these and other uncertainties should be identified and addressed on a case-by-case basis for each pesticide formulation (active ingredient and adjuvant). Where uncertainties cannot be resolved using the best available scientific literature, the benefit of the doubt should be given to the threatened or endangered species in question.

It is becoming increasingly evident that the indirect effects of contaminants on ecosystem structure and function are a key factor in determining a toxicant's cumulative risk to aquatic organisms (Preston 2002). Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to the acutely toxic effects of herbicides. Therefore, chemicals can potentially impact the structure of aquatic communities at concentrations that fall below the threshold for direct biological impairment in salmon. The integrity of the aquatic food chain is an essential biological requirement for salmon, and the possibility that herbicide applications will limit the productivity of streams and rivers should be considered in an adverse affect analysis.

Human activities that modify the physical or chemical characteristics of streams often lead to changes in the trophic system that ultimately reduce salmonid productivity (Bisson and Bilby 1998). In the case of herbicides, a primary concern is the potential for impacts on benthic algae. Benthic algae are important primary producers in aquatic habitats, and are thought to be the principal source of energy in many mid-sized streams (Minshall 1978, Vannote *et al.* 1980, Murphy 1998). Critically, herbicides can cause significant shifts in the composition of benthic algal communities at concentrations in the low parts per billion (Hoagland *et al.* 1996). Moreover, based on the data available, herbicides have a high potential to elicit significant effects on aquatic microorganisms (DeLorenzo *et al.* 2001). In many cases, however, the acute sensitivities of algal species to herbicides are not known. In addition, Hoagland *et al.* (1996) identified key uncertainties in the following areas: (1) The importance of environmental modifying factors such as light, temperature, pH, and nutrients; (2) interactive effects of herbicides where they occur as mixtures; (3) indirect community-level effects; (4) specific modes of action; (5) mechanisms of community and species recovery; and (6) mechanisms of tolerance by some taxa to some chemicals. Herbicide applications have the potential to impair autochthonous production and, by extension, undermine the trophic support for stream ecosystems. However, existing data gaps make it difficult to estimate the degree of ecological risk.

The potential effects of herbicides on prey species for salmon are also an important concern. Juvenile Pacific salmon feed on a diverse array of aquatic macroinvertebrates (*i.e.* larger than 595 microns in their later instars or mature forms, Cederholm *et al.* 2000). Terrestrial insects, aquatic insects, and crustaceans comprise the large majority of the diets of fry and parr in all salmon species (Higgs *et al.* 1995). Prominent taxonomic groups include Chironomidae (midges), Ephemeroptera (mayflies), Plecoptera (stoneflies), Tricoptera (caddisflies), and Simuliidae (blackfly larvae) as well as amphipods, harpacticoid copepods, and daphniids. Chironomids in particular are an important component of the diet of nearly all freshwater salmon fry (Higgs *et al.* 1995). In general, insects and crustaceans are more acutely sensitive to the toxic effects of environmental contaminants than fish or other vertebrates. However, with a few exceptions (*e.g.* daphniids), the impacts of pesticides on salmonid prey taxa have not been widely investigated. Where acute toxicity for salmonid prey species are available, however, they should be used to estimate the potential impacts of herbicide applications on the aquatic food chain.

The growth of salmonids in freshwater systems is largely determined by the availability of prey (Chapman 1966, Mundie 1974). For example, supplementation studies (*e.g.* Mason 1976) have shown a clear relationship between food abundance and the growth rate and biomass yield or productivity of juveniles in streams. Therefore, herbicide applications that kill or otherwise reduce the abundance of macroinvertebrates in streams can also reduce the energetic efficiency for growth in salmonids. Less food can also induce density-dependent effects; for example, competition among foragers can be expected to increase as prey resources are reduced (Ricker 1976). These considerations are important because juvenile growth is a critical determinant of freshwater and marine survival (Higgs *et al.* 1995). For example, a recent study on size-selective mortality in chinook salmon from the Snake River found that naturally-reared wild fish did not return to spawn if they were below a certain size threshold when they migrated to the ocean (Zabel and Williams 2002) . There are two primary reasons why mortality is higher among smaller salmonids. First, fish that have a slower rate of growth suffer size-selective predation during their first year in the marine environment (Parker 1971, Healy 1982, Holtby *et al.* 1990). Growth-related mortality occurs late in the first marine year and may determine, in part, the strength of the year class (Beamish and Mahnken 2001). Second, salmon that grow more slowly may be more vulnerable to starvation or exhaustion (Sogard 1997).

The proposed action may also affect habitat quality in Johnson Creek. Since the project design criteria includes the application of triclopyr in areas within the 100-year floodplain or where the herbicide may be transported to the floodplain or surface waters, stream shade or bank stability may be affected. The goal of the proposed action is to remove non-native riparian vegetation and replace it with native vegetation that will support improved ecosystem processes in the long term. However, there will be a three to ten-year gap between the loss of vegetation and re-establishment of the new vegetation. During this time period, riparian shade will be reduced and the streambanks will be more vulnerable to erosion.

In summary, the quality of salmon freshwater habitat is determined by a combination of physical, chemical, and biological factors (Cederholm *et al.* 2000). The transport of herbicides to surface waters is a chemical form of habitat modification that can potentially impair the biological components of a properly functioning aquatic ecosystem. These impacts can, in turn, impair the growth and survival of salmonids.

2.1.5.6 Likelihood of Direct Effects

NOAA Fisheries defines harm as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR 222.102). The behavioral patterns, and their underlying physiological processes, are measured at the scale of individual animals, and are essential for the viability and genetic integrity of wild populations. It is important to note that many toxicological endpoints or biomarkers may not have clear implications for the health or performance of individual fish (*e.g.* a small percentage change in the activity of a certain enzyme, an increase in oxygen consumption, the formation of pre-neoplastic hepatic lesions). For these kinds of data, it may not be possible to infer a significant loss of function at higher scales of biological complexity.

An analysis of the direct impacts of herbicides on salmonids should relate the site-specific exposure conditions (*i.e.* expected environmental concentration, bioavailability, and exposure duration) to the known or suspected impacts of the chemical on the health of exposed fish. Where possible, such analyses should consider: (1) The life history stage (and any associated vulnerabilities) of the exposed salmonid; (2) the known or suspected mechanism of toxicity for the active ingredient (or adjuvant) in question; (3) local environmental conditions that may modify the relative toxicity of the contaminant; and (4) the possibility of additive or synergistic interactions with other chemicals that may enter surface waters as a result of parallel or upstream land use activities.

Based on the analysis provided in the BA, and discussed above, it appears that the proposed herbicide use is unlikely to cause fish kills when used according to the EPA label. Therefore, for threatened or endangered salmonids, the vast majority of harmful direct effects are expected to be from sublethal exposure. The possibility of sublethal effects leading to ecological death (Kruzynski et al. 1994) or other deleterious biological outcomes is a threat to listed species from the proposed action. The toxicological endpoints identified below are generally considered to be important for the fitness of salmonids and other fish species. They include: (1) Direct mortality at any life history stage; (2) an increase or decrease in growth; (3) changes in reproductive behavior; (4) a reduction in the number of eggs produced, eggs fertilized, or eggs hatched; (5) developmental abnormalities, including behavioral deficits or physical deformities; (6) reduced ability to osmoregulate or adapt to salinity gradients; (7) reduced ability to tolerate shifts in other environmental variables (*e.g.* temperature or increased stress); (8) an increased susceptibility to disease; (9) an increased susceptibility to predation; and (10) changes in migratory behavior.

Most of these endpoints have not been investigated for triclopyr. Information on sublethal effects of glyphosate is available for many of the above endpoints, and of those reported, glyphosate appears to carry a low risk for sublethal effects. Very little is known about potential sublethal effects of triclopyr but results reported in the Reregistration Eligibility Decision document by the U.S. Enironmental Protection Agency (1998) indicate that the triclopyr degradate, TCP, is considered to be persistent in aquatic environments and aquatic concentrations of TCP may exceed 0.01 of the LC_{50} for fish. Furthermore, aquatic invertebrate reproductive impairment may occur at levels greater than 80.7 ppm. The consequences of these sublethal effects are loss of physiological or behavioral functions the can adversely affect the survival, reproductive success, or migratory behavior of individual fish. Such effects, in turn, can be expected to reduce the viability of wild populations.

Additional endpoints could also be significant if a clear relationship is established between the observed impairment and the "essential biological requirements" of salmonids – *i.e.* the likelihood that the exposed animal will survive the various phases of its life cycle and return to its natal river system to spawn.

2.1.5.7 Physical Effects of Herbicides on Watershed and Stream Function

NOAA Fisheries defines the habitat needs of listed salmon and steelhead based on the physical and biological features that are essential to support the listed species. Essential habitat features include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space and safe passage. The proposed invasive species management strategy will occur within habitat for LCR chinook salmon and LCR steelhead has the potential to affect substrate, water quality, water temperature, food, and riparian vegetation.

Rain events could transport the chemicals from the riparian areas where they are applied into adjacent and downstream waters. While risk assessment estimates indicate the project may alter the existing water quality and potentially the prey base of LCR chinook salmon and LCR steelhead, it is expected that implementation of project BMPs as described above would minimize the risk that the two herbicides and surfactant LI-700 would reach downstream in concentrations sufficient to elicit lethal effects. All effects discussed in the previous sections also apply to habitat.

The purpose of the herbicide applications is to remove the existing non-native vegetation. Until the native vegetation is able to establish and grow, the action area will be vulnerable to erosion, which could increase the input of sediment into Johnson Creek, affecting turbidity and substrate. Water temperatures may be affected until the new plantings establish and grow to sufficient size to shade the stream.

Project BMPs will be employed to minimize drift or chemical leaching contamination. However, no buffer strips will be used because the intent of the proposed action is to remove existing vegetation adjacent to the stream. It is unknown how effective the BMPs will be in preventing chemicals from entering Johnson Creek.

2.1.6 Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as those effects of "future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or have been) reviewed through separate section 7 consultation processes. Therefore, these actions are not considered cumulative to the proposed action.

The land use surrounding the Gresham Woods site is primarily urban, including residential, commercial and industrial uses. In the upper Johnson Creek watershed, rural farms and nurseries dominate the land use. The Gresham Woods site is owned and managed by the City of Gresham. NOAA Fisheries is not aware of any specific future non-Federal activities within the action area that would cause additional impacts to listed species beyond what presently occurs. The City of Gresham plans to continue to restore habitat features on the Gresham Woods site. The density of development surrounding Gresham Woods will continue to increase. The use of chemical fertilizers, herbicides, or pesticides is likely to occur on state and private lands in the action area as part of normal land management practices, but no specific information is available regarding their use. Gresham has an Integrated Pest Management program that minimizes the use of chemicals. However, chemical use on surrounding and upstream lands is likely to continue. It is possible that waters contaminated by the proposed action could mix with waters contaminated from non-Federal pesticide use, and harm listed fish through additive or synergistic effects of the chemical mixture. The potential for, and severity of, harmful additive or synergistic effects is unknown.

2.1.7 Synthesis

The BMPs proposed by the USFWS are designed to minimize the movement of chemicals into the water. The plants will be cut back mechanically prior to chemical use, and chemical use will be minimized as the invasive plants are controlled. Furthermore, with the use of Garlon® 3a (triclopyr), grasses will not be affected, which will reduce the potential for erosion and destabilization of the streambanks.

Johnson Creek currently supports anadromous fish at numbers far below estimated historic levels. Low fish densities occur partly from past and present land use in the action area, and partly from factors outside the area (such as fish passage conditions, or fluctuations in population size due to ocean conditions). Given these circumstances, actions that significantly perpetuate or worsen conditions affecting the survival and recovery of listed fish might jeopardize the continued existence of listed anadromous fish. The spectrum of potential effects of the proposed invasive species management activities on listed fish ranges from modest benefits, to adverse effects, depending on case-by-case circumstances such as the toxicity of the particular herbicide, effectiveness of BMPs in keeping chemicals out of the water, or effects of weed persistence on the stream, riparian area, or watershed hydrology at a particular location. Benefits to listed fish might occur if aquatic organisms are not exposed to toxic herbicide concentrations, and where weed eradication restores native riparian vegetation and floodplain function altered by the invasive weeds. Adverse effects might occur if aquatic organisms are exposed to toxic concentrations of chemicals.

The likelihood of harm to listed fish from the proposed herbicide use depends on both the toxicity of the product, and the timing, duration, and concentration of chemical exposure. The scientific literature on the two herbicides and their combinations indicates relatively low toxicity, for those particular assays where information is available; however, information on potential toxicity is spotty and incomplete. Neither of the proposed herbicides have complete scientific or commercial research on potential sublethal effects (*e.g.* developmental, endocrine/systemic, or behavioral reactions), or on indirect effects on prey species or primary producers, but the information that is available indicates that harm would occur if fish are exposed to concentrations similar to those reported in the particular studies. NOAA Fisheries defines harm as "...significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR 222.102).

Gaps in availability of toxicity assays reported in the literature leave open to question the likelihood of harm that might occur from sub-lethal effects for which no test results have been reported, such as changes in spontaneous swimming activity, swimming capacity, feeding and spawning behavior, or vulnerability to predation (Little *et al.* 1990, Weis *et al.* 2001). An uncertain level of risk exists from the use of pesticides that have not been thoroughly screened, because sublethal effects, in particular, can occur at concentrations several orders of magnitude below concentrations where lethal effects begin to appear. Of the herbicides proposed for use, glyphosate (Rodeo® formulation) has the most complete information available, and is least likely to harm listed fish. For triclopyr, there is spotty information reported on the effects of the product formulations (active ingredient + inert ingredients + surfactant + carrier) on listed fish and other aquatic organisms.

Although there is considerable uncertainty regarding the toxicity of some of the herbicides, the low potential for exposure of listed fish to the herbicides mitigates some of the risk. Chinook salmon are unlikely to be present in the project reach, and the herbicide concentrations should be substantially diluted by the time flows reach suitable chinook habitat. Steelhead may be present in the project reach at extremely low densities, and consequently have a greater potential to be exposed to sublethal concentrations of chemicals.

As with toxic effects, there is some uncertainty about the effectiveness of the BMPs and the amount of chemical expected to reach the water. The scientific literature reviewed in this Opinion indicates that BMPs generally reduce the amount of herbicides reaching the water, but do not prevent it from entering the waterbody. Results from generalized fate and transport modeling exercises indicate exposure of aquatic organisms to the herbicides for a "typical" forest herbicide action is generally expected to be well-below concentrations that would cause lethal effects (given the caveats in the preceding paragraphs), and below concentrations where there are obvious sub-lethal effects. No fate and transport studies have been done for localized application of herbicides in riparian areas. BMPs built into the proposed action are expected to minimize potential exposure. For example, the mechanical treatment of the invasive plants prior to herbicide application will greatly minimize the amount of chemicals need, and additional BMPs are expected to minimize the amount of chemicals reaching the water. Nevertheless, given the uncertainties of BMP effectiveness and chemical fate and transport modeling predictions, listed fish (particularly steelhead) could be harmed by exposure to herbicide concentrations that cause sublethal or indirect environmental effects.

Given the relatively modest toxicity of the chemicals and the low levels of expected chemical exposure, adverse effects of herbicide treatment are not expected, but given the gaps in information on sublethal effects and the effectiveness of BMPs, the proposed herbicide treatments could harm listed fish in certain circumstances, as a result of: (1) Accidental spills; (2) failure of BMPs to keep chemical concentrations below expected levels; (3) unexpected toxic effects that have not been reported in the scientific literature; (4) additive or synergistic effects of herbicides from the proposed action and herbicides used by non-Federal parties in the action area; or (5) indirect effects on the prey base or riparian shade.

Due to the limited extent and duration of herbicide treatment, the above mentioned effects are expected to be localized and of a short duration. If BMPs are unsuccessful in keeping herbicides from reaching water, effects to listed salmonid are most likely to be sublethal, except in the case of a spill. If a spill was to occur directly into water, lethal effects to list salmonids could occur over an area proportional to the size of the spill. However, NOAA Fisheries believes the chance of this occurring is low.

2.1.8 Conclusion

NOAA Fisheries has determined that, when the effects of the subject actions addressed in this Opinion are added to the environmental baseline and cumulative effects occurring in the action area, they are not likely to jeopardize the continued existence of LCR chinook salmon or LCR steelhead. The proposed action is also unlikely to impair physical habitat conditions because current riparian vegetation is poorly functioning, and the intent of the proposed action is to improve riparian function over the long term.

2.1.9 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, minimize or avoid adverse modification of critical habitat, and to develop additional information. NOAA Fisheries believes the following conservation recommendations are consistent with these obligations, and therefore should be carried out by the USFWS.

1. The USFWS should evaluate the long-term need for continued chemical (herbicide + pesticide) treatment within Gresham Woods.

2. If the USFWS determines in step #1 above that there is a long-term need for chemical treatment at Gresham Woods, they should develop a long-term, statistically sound, repeatable chemical monitoring program that evaluates the effectiveness and reliability of BMPs designed to minimize chemicals from reaching surface waters, surface-groundwater mixing zones, and non-target vegetation at concentrations that can result in

lethal and sublethal effects to salmon and steelhead, and diminish the quality, quantity, and function of riparian vegetation.

a. The monitoring program should be designed to evaluate different application methods, chemical-specific characteristics to include all chemical combinations used for noxious weed management, and landscape characteristics. Water, streambed sediments, and soil samples should be collected for each type of treatment, with several replicates for each chemical and treatment type. Samples should include pre- and post-treatment monitoring.

b. Level of detection for each chemical constituent should be established at concentrations that elicit lethal and sublethal effects to salmon and steelhead. Level of detection should be based on an LC_{10}, not an LC_{50}, for salmon and steelhead.

c. Level of detection should include active ingredients, inert ingredients, surfactants, emulsifying agents, and wetting agents.

d. Develop a sampling design for monitoring the persistence of herbicides in riparian soils and to determine concentrations and residence time of herbicides that enter streams and rivers. The sampling design should provide a statistical estimate of chemical exposure, and should be sufficient to determine if the assumptions in this Opinion regarding exposure are correct.

3. The USFWS should work with chemical manufacturers to determine toxicity of inert ingredients and adjuvants to salmon and steelhead, cold water macroinvertebrates, and freshwater flora.

4. The USFWS should integrate information from the literature review, monitoring program, and efforts carried out with chemical manufacturers into future integrated noxious weed management programs.

In order for NOAA Fisheries to be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed salmon and steelhead or their habitats, we request notification of the achievement of any conservation recommendations when the USFWS submits its annual report for this consultation.

2.1.10 Reinitiation of Consultation

Consultation must be reinitiated if: (1) The amount or extent of taking specified in the incidental take statement is exceeded, or is expected to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; (3) the action is modified in a way that causes an effect on listed species that was not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16). In instances where the amount or extent of authorized incidental take is exceeded, any operations causing such take must cease pending conclusion of the reinitiated consultation.

2.2 Incidental Take Statement

Section 9 and rules promulgated under section 4(d) of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, and sheltering. Harass is defined as actions that create the likelihood of injuring listed species by annoying it to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

2.2.1 Amount or Extent of Take

NOAA Fisheries anticipates that the proposed action covered by this Opinion is reasonably certain to result in incidental take of LCR chinook salmon and LCR steelhead because: (1) The proposed action is reasonably certain to kill, or more likely cause harm to, individual salmon and steelhead through lethal and sublethal exposure to herbicides; (2) the proposed action is reasonably certain to adversely affect essential features of habitat that would in turn reduce the survival of the subject species; (3) recent and historical data indicates the subject species is known to occur in the action area or downstream of the action area; and (4) the proposed action is likely to adversely affect availability of invertebrate prey through toxic effects of herbicides.

Despite the use of best scientific and commercial data available, NOAA Fisheries cannot quantify a specific amount of incidental take of individual fish or incubating eggs for this action. The amount of take depends on the species present, life stage, and the number of fish present when treatment activities occur. For the purposes of this Opinion, the extent of lethal and non-lethal take is defined as and limited to harm and harassment in the proposed treatment areas of Gresham Woods. Herbicide treatment would occur from 2003 to 2005, for a maximum of three treatments per year.

2.2.2 Reasonable and Prudent Measures

Reasonable and prudent measures are non-discretionary measures to minimize take, that are not already part of the description of the proposed action. They must be implemented as binding conditions for the exemption in section 7(a)(2) to apply. The USFWS has the continuing duty to regulate the activities covered in this incidental take statement. If the USFWS fails to require contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the contract, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. NOAA Fisheries believes that activities carried out in a manner consistent with these reasonable and prudent measures will not necessitate further site-specific consultation.

Activities carried out which do not comply with the reasonable and prudent measures are not covered by this Opinion and will require further consultation.

NOAA Fisheries believes that based on: (1) The lack of sound and reliable scientific data on sublethal effects to salmon and steelhead from exposure to herbicides; (2) the uncertainty of BMP effectiveness; (3) the presence of salmon and steelhead (incubating eggs, juveniles, adults) in the action area during herbicide applications, that the following reasonable and prudent measures are necessary and appropriate to minimize take of LCR chinook salmon or LCR steelhead resulting from implementation of the action. These reasonable and prudent measures will also minimize adverse effects on designated critical habitat.

The USFWS shall:

1. Minimize the extent of incidental take associated with herbicide application by implementing BMPs that minimize the movement of herbicides to surface and surface-ground water mixing zones.

2. Monitor the effectiveness of BMPs, conservation recommendations, and terms and conditions designed to minimize incidental take, and submit a report to NOAA Fisheries.

2.2.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, USFWS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. To implement reasonable and prudent measure #1 (minimize the movement of herbicides to surface and surface-ground water mixing zones), the USFWS shall ensure that:

    a. All BMPs described in section 1.2.1 of this Opinion are implemented.
    b. Spill response procedures have been developed and reviewed with each applicator before commencing herbicide application operations.
    c. All chemical storage, chemical mixing, and post-application equipment cleaning is completed in such a manner as to prevent the potential contamination of any RHCA, perennial or intermittent waterbody, unprotected ephemeral waterway, or wetland.
    d. Use only those sprayers with a single nozzle, such as back pack or hand sprayers, to spray herbicides in the riparian zone.
    e. All hand operated application equipment is leak and spill proof.
    f. Herbicide applications are prohibited when precipitation is occurring or forecast to occur within the next 24 hours, or if windspeeds are over 6 miles per hour.
    g. A licensed/certified herbicide applicator is conducting all spray projects.
    h. Only the minimum area necessary for the control of noxious weeds is treated.

i. All equipment used for transportation, storage, or application of chemicals be maintained in an area that is constructed to fully contain all chemicals, and not loaded or unloaded within 300 feet of any perennial or intermittent stream or water body.

2. To implement reasonable and prudent measure #2 (monitoring), the USFWS shall ensure that:

   a. Non-target plant mortality in riparian areas will be monitored if mortality of non-target plants is affecting riparian function.
   b. USFWS shall work with NOAA Fisheries (Oregon Habitat Branch and the Community Restoration Program) to develop a study at the Gresham Woods site that examines whether mechanical treatment only is effective at eradicating invasive plants. The need for a study of this type is based on questions about the appropriate use of chemicals in riparian restoration. A series of small plots should be designed and monitored through time that use mechanical treatment only.
   c. After treatment each year, provide NOAA Fisheries with a list of the following information for each locations to be treated:
      i. Acres treated
      ii. Riparian acres treated
      iii. Application method
      iv. Herbicide used (including concentration and amount)
      v. Date of treatment, weather
      vi. Name of applicator
      vii. Report of accidents, if any.
   d. Monitoring results will be reported to NOAA Fisheries (Nancy Munn 503.231.6269) after the field season and before weed control activities if similar activities are proposed in subsequent years.
   e. If a listed species specimen is found dead, sick, or injured, as a possible result of the proposed action or other unnatural cause, initial notification should be made to the NOAA Fisheries Law Enforcement Office, located at Vancouver Field Office, 600 Maritime, Suite 130, Vancouver, Washington 98661; telephone: 360/418-4246. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered and threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

d. Monitoring reports will be submitted to:

National Marine Fisheries Service
Oregon Habitat Branch
Attn: 2003/00511
525 NE Oregon Street
Portland, OR 97232

3. MAGNUSON-STEVENS ACT

3.1 Magnuson-Stevens Fishery Conservation and Management Act

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires the inclusion of EFH descriptions in Federal fishery management plans. In addition, the MSA requires Federal agencies to consult with NOAA Fisheries on activities that may adversely affect EFH.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting the definition of EFH: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50CFR600.110).

Section 305(b) of the MSA (16 U.S.C. 1855(b)) requires that:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;
- NOAA Fisheries shall provide conservation recommendations for any Federal or state activity that may adversely affect EFH;
- Federal agencies shall within 30 days after receiving conservation recommendations from NOAA Fisheries provide a detailed response in writing to NOAA Fisheries regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NOAA Fisheries, the Federal agency shall explain its reason for not following the recommendations.

The MSA requires consultation for all actions that may adversely affect EFH, and does not distinguish between actions within EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NOAA Fisheries is required by Federal agencies undertaking, permitting or funding activities that may adversely affect EFH, regardless of its location.

3.2 Identification of EFH

The Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Pacific salmon: Chinook (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O.gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the *Pacific Coast Salmon Plan* (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based on this information.

3.3 Proposed Action

The proposed action is detailed above in section 1.2 of this document. While the Gresham Woods site is 71 acres of publicly owned and managed land, the action area for this consultation includes 20 contiguous acres on the property, ranging from the streambank up to 250 feet from the top of the bank, along approximately 2,000 linear feet of Johnson Creek. The action area includes the streambed, streambanks, and riparian area of Johnson Creek from the upstream edge of the 20-acre parcel, downstream to the edge of the Gresham Woods site. This area has been designated as EFH for various life stages of chinook salmon and coho salmon. Both species are currently known to occur in the Johnson Creek drainage. Coho salmon were observed in 1993 just downstream of Gresham, so it is possible that coho could occur in the action area. It is unlikely that chinook salmon occur in the project vicinity, but they may be found in low numbers several miles downstream near the confluence with the Willamette River.

3.4 Effects of Proposed Action

As described in detail in the ESA portion of this consultation, the proposed activities may result in detrimental, short-term, adverse effects to water quality. However, over the long term as native shrubs, trees and grasses become established, it is anticipated that water quality (temperature, sediment/turbidity) and other habitat parameters will improve.

3.5 Conclusion

NOAA Fisheries believes that the proposed action will temporarily adversely affect the EFH for chinook salmon and coho salmon.

3.6 EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations for any Federal or state agency action that would adversely affect EFH. In addition to conservation measures proposed for the project by the USFWS, all of the reasonable and prudent measures and the terms and conditions contained in sections 2.2.3 and 2.2.4, respectively, of the ESA portion of this Opinion are applicable to salmon EFH. Therefore, NOAA Fisheries incorporates each of those measures here as EFH conservation recommendations.

3.7 Statutory Response Requirement

The MSA (section 305(b)) and 50 CFR 600.920(j) requires the USFWS to provide a written response to NOAA Fisheries' EFH conservation recommendations within 30 days of its receipt of this letter. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. If the response is inconsistent with NOAA Fisheries' conservation recommendations, the USFWS shall explain its reasons for not following the recommendations.

3.8 Supplemental Consultation

The USFWS must reinitiate EFH consultation with NOAA Fisheries if either the action is substantially revised or new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920).

4. LITERATURE CITED

Section 7(a)(2) of the ESA requires biological opinions to be based on "the best scientific and commercial data available." This section identifies the data used in developing this Opinion in addition to the BA and additional information requested by NOAA Fisheries and provided by the COE.

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